# UNITIZATION OF SYLLABUS & TEACHING PLAN

**Department of MATHEMATICS**

**Bankura Christian College**

## B.Sc. Honours in Mathematics

**3rd Semester (July to December, 2023), A.Y.: 2023 – 24**

**Subject: Mathematics** **Paper: Core T7**

**Course Title: ODE & Multivariate Calculus – I**

**Course Instructor: Dr Subhasis Bandyopadhyay**

**Course Learning Outcomes:** This course will enable the students to

- Grasp the concepts of general solutions of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
- Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines
- Learn conceptual variations from one variable to several variables in calculus.
- Develop concepts on limit and continuity of functions of two or more variables, their partial derivatives, total derivative and differentiability and their application.
- Apply multivariable calculus for solving optimization problems.

## Syllabus:

### Unit 1

First order differential equations: Exact differential equations and integrating factors, special integrating factors and transformations, linear equations, Bernoulli equations and reducible to linear forms, the existence and uniqueness theorem of Picard (Statement only).

### Unit 2

First order higher degree equations solvable for $x$, $y$ and $p$. Clairaut's equations and singular solution.

### Unit 3

Linear differential equations of second order, Wronskian: its properties and applications, C.F., P.I. and General solutions, D operator method, Euler equation, method of undetermined coefficients, method of variation of parameters. Special forms.

### Unit 4

System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Simultaneous equations of form 2, Total differential equations.

### Unit 5

System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients.

### Unit 6

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

**Unit 7**

Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order).

**Unit 8**

Concept of neighbourhood of a point in $\mathbb{R}^n$ $(n > 1)$, interior point, limit point, open set and closed set in $\mathbb{R}^n$ $(n > 1)$.

**Unit 9**

Functions from $\mathbb{R}^n$ $(n > 1)$ to $\mathbb{R}^m$ $(m \geq 1)$, limit and continuity of real-valued functions of two or more variables. Partial derivatives, total derivative and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, theorems on equality of mixed partial derivatives of two variables, directional derivatives, Homogeneous functions and Euler's theorems. Extrema of functions of two and three variables, method of Lagrange multipliers, constrained optimization problems.

## Reference Books :


- D.A. Murray, Introductory course in Differential Equations, Andesite Press, 2017.
- H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications,C.B.S Publisher & Distributors, Delhi, 1985.
- G. F. Simmons, Differential Equations, Tata McGraw Hill, 2017.
- S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- K.C. Ghosh and R.K. Maity, An Introduction to Analysis: Differential Calculus (Part II), New Central Book Agency (P) Ltd., 2008.
- K.C. Ghosh and R.K. Maity, An Introduction to Differential Equations, New Central Book Agency (P) Ltd., 2011.
- H.R. Beyer, Calculus and Analysis, Wiley, 2010.

## Teaching Plan:

| MONTH & YEAR | WEEK | PORTIONS | No. of Lectures |
|---|---|---|---|
| August 2023<br><br>[Date of Commencement of Regular Classes: 16 – 08 – 2023] | 1 | ---------- | ------ |
| | 2 | ---------- | ------ |
| | 3 | **First order differential equations:** Exact differential equations and integrating factors, special integrating factors and transformations. | **3** |
| | 4 | Linear equations, Bernoulli equations and reducible to linear forms, the existence and uniqueness theorem of Picard (Statement only). | **5** |
| | 5 | First order higher degree equations solvable for $x$, $y$ and $p$. Clairaut's equations and singular solution. | **2** |
| September 2023 | 1 | Linear differential equations of second order, Wronskian: its properties and applications. | **1** |
| | 2 | C.F., P.I. and General solutions, D operator method, Euler equation. | **3** |
| | 3 | Method of undetermined coefficients, method of variation of parameters. Special forms. | **5** |
| | 4 | System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Simultaneous equations of form 2, Total differential equations. | **5** |
| | 5 | Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions. | **5** |
| October 2023 | 1 | Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order). | **3** |
| | 2 | Power series solutions of ODE …. Contd…<br>Remaining portions of Differential Equations.<br>**Revision /Class Test/Assignments** | **5** |
| | 3 | Concept of neighbourhood of a point in $\mathbb{R}^n$ $(n > 1)$, interior point, limit point, open set and closed set in $\mathbb{R}^n$ $(n > 1)$. | **2** |
| | 4 | **Puja Holidays (18-10-2023 TO 28-10-2022)**<br>**As per Academic Calendar** | ------ |
| | 5 | **Puja Holidays** | ------ |
| November 2023 | 1 | Functions from $\mathbb{R}^n$ $(n > 1)$ to $\mathbb{R}^m$ $(m \geq 1)$, limit and continuity of real-valued functions of two or more variables. | **3** |
| | 2 | Partial derivatives and related problems. | **5** |
| | 3 | **Holidays (Kali Puja, Bhatridwitiya etc.)(12-11-23 To 16-11-23)** | ------ |
| | 4 | Total derivative and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters. | **5** |
| | 5 | Theorems on equality of mixed partial derivatives of two variables. Directional derivatives. | **3** |
| December 2023 | 1 | Homogeneous functions and Euler's theorems and related problems. | **1** |
| | 2 | Homogeneous functions and Euler's theorem….. contd… | **5** |
| | 3 | Extrema of functions of two and three variables. | **5** |
| | 4 | Method of Lagrange multipliers, constrained optimization problems.<br>**Revision /Class Test/Assignments** | **4** |
| | 5 | **Christmas Holidays & Study Leave** | |